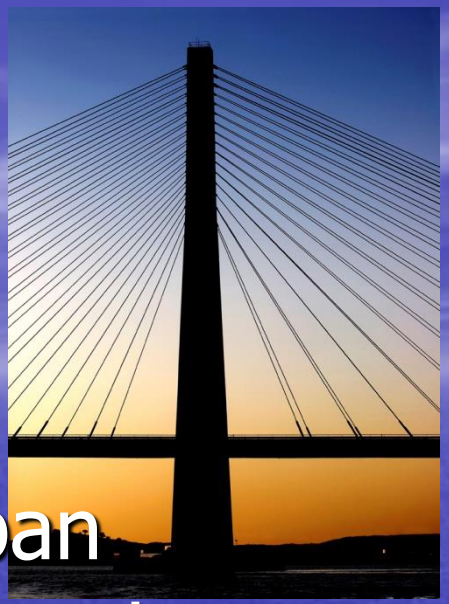
Bridges

"Bridging the Gap"

Introduction to Bridges



- Civil engineers design bridges to span things like rivers, roads, train tracks, etc.
- The type of bridge constructed depends on the types of materials the bridge can be attached to, the length of the span and money available to build the bridge.

In the Beginning…..

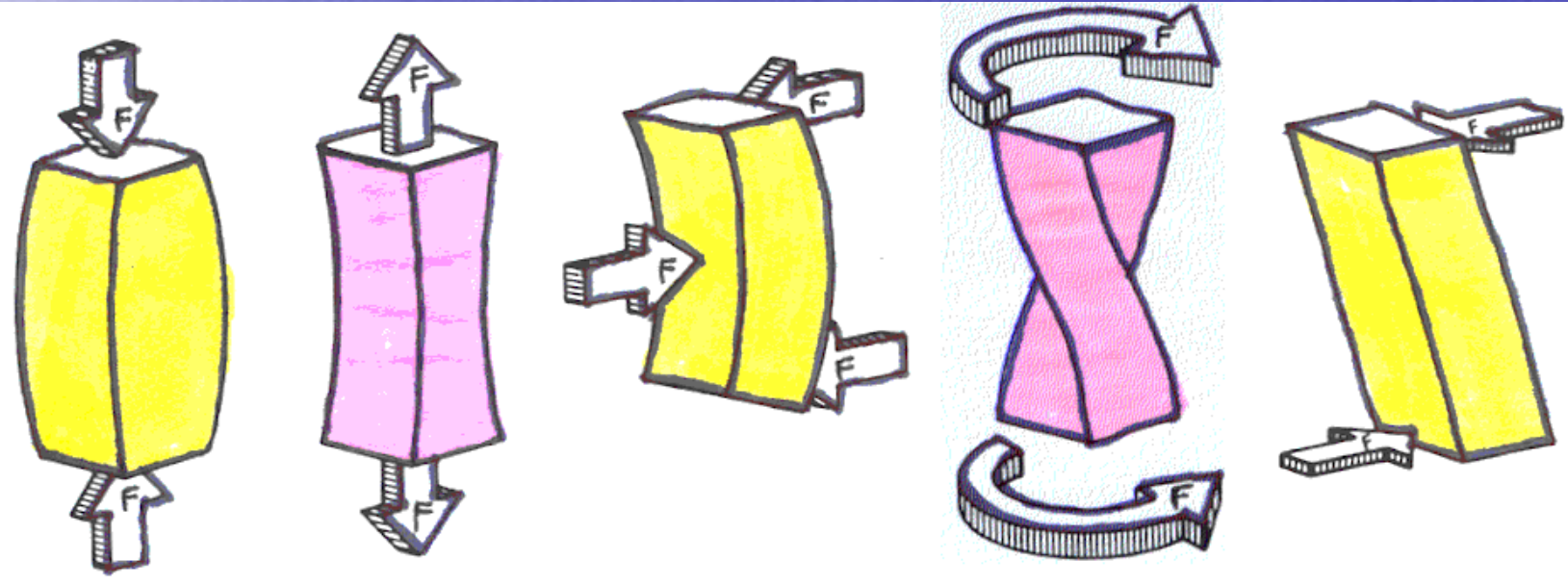
- First they were made of wood, stone or even vines – whatever was available
- Romans the first great bridge builders
  - Some still standing today
- Iron first used in 1700s
- Concrete in the mid 1800s
- Steel in the late 1800s
- Today – use high-strength, light- weight composites

Forces on Bridges

There are 4 main forces that act on bridges:

1. Tension – Stretching a material
2. Compression- Squeezes or shortens a material
3. Shear Force - produced by sliding
4. Torsion – Twisting material

Forces on Bridges



Compression Tension Bending Torsion Shearing

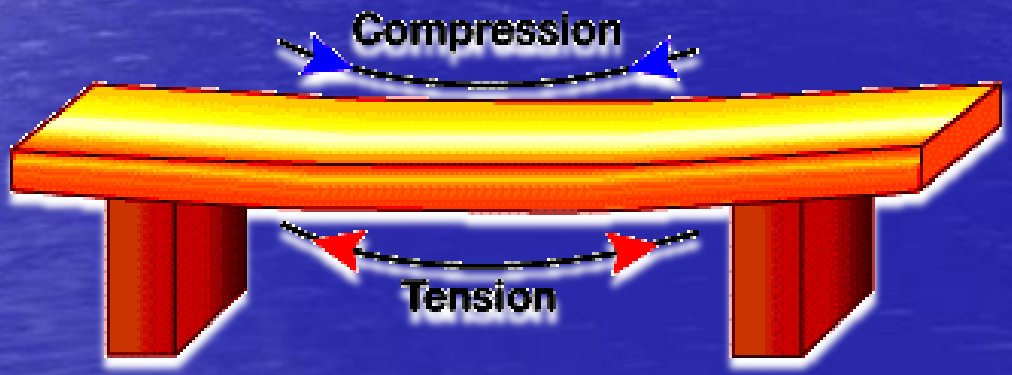
Bridge Vocabulary

- Dead Load – the bridge's own weight
- Environmental Load – the bridge's resistance to natural forces such as wind and earthquakes
- Live Load – the bridge's traffic

A Collage of Bridges

Beam Bridges

- A beam bridge is a rigid horizontal structure that rests on two piers, one at each end.
- The weight of the bridge and any traffic on it is directly supported by the piers.
- The weight is traveling directly downward.



Advantages of beams

- The supports can be simple vertical piers.
- It may be built away from the final position, and lifted swiftly into place.

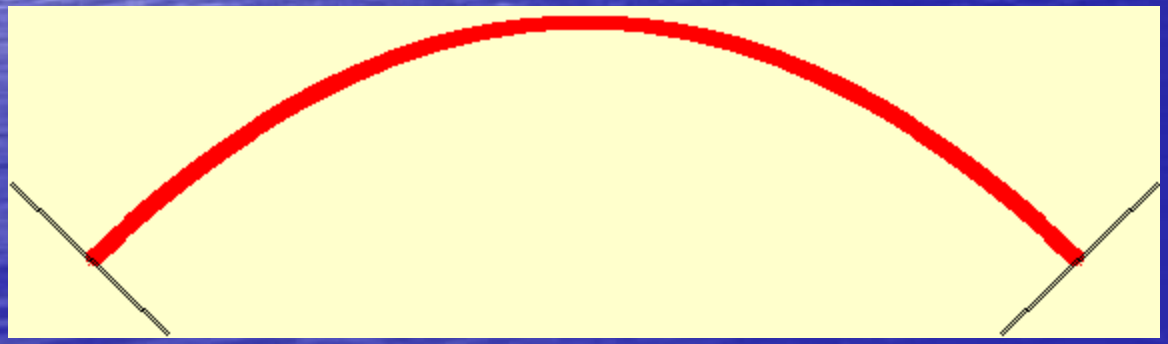
Disadvantages of beams

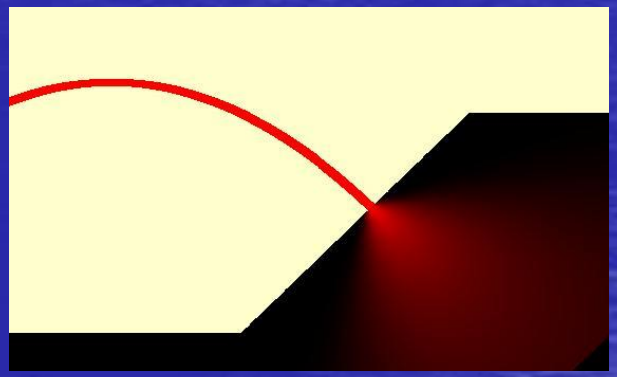
- The beam maintains its shape by means of the opposed tension and compression, and by the shear forces also.

Beam Bridge

Arch Bridge

- An arch bridge is a type of bridge in which its weight is carried outward along the curve to supports at each end.
- Arch bridges can have a span of up to 1,700 feet.





Advantages of arches

- The entire arch is in compression. The compression is transferred into the abutments.
- The absence of tension in the arch means that it can sustain much greater spans than beams can achieve

Disadvantages of arches

- An arch cannot stand until it is complete. The cantilever method cannot be used for masonry arches or concrete arches.

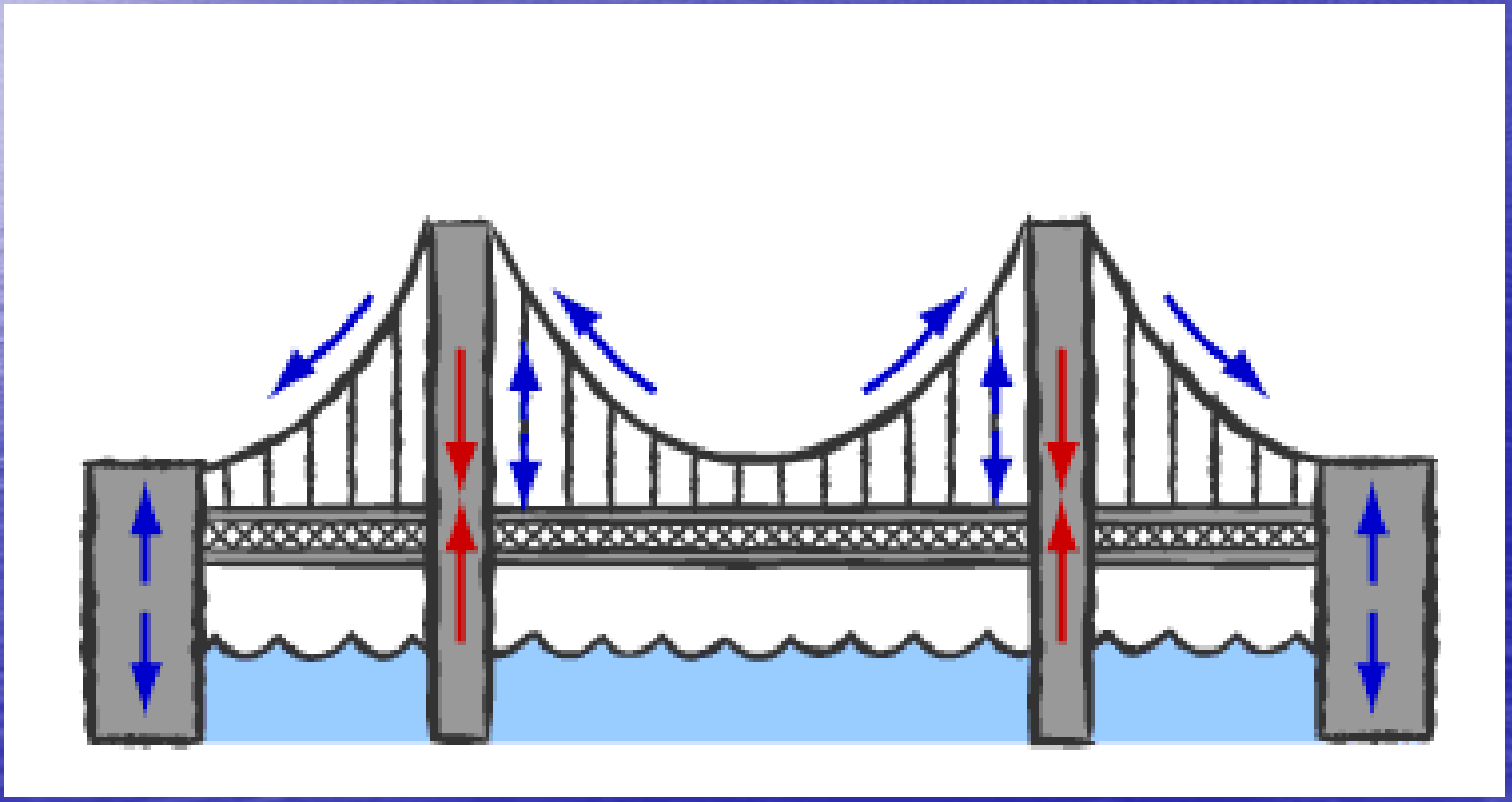
Basic Arch Bridge

Composite Arch Bridge

Composite Arch Bridge

Suspension Bridges

A bridge in which the roadway is hung from strong cables that pass over two towers.



Advantages of suspension bridges

- The main sustaining members, the cables or chains, are purely in tension.
- Design is relatively simple.

Disadvantages of suspension bridges

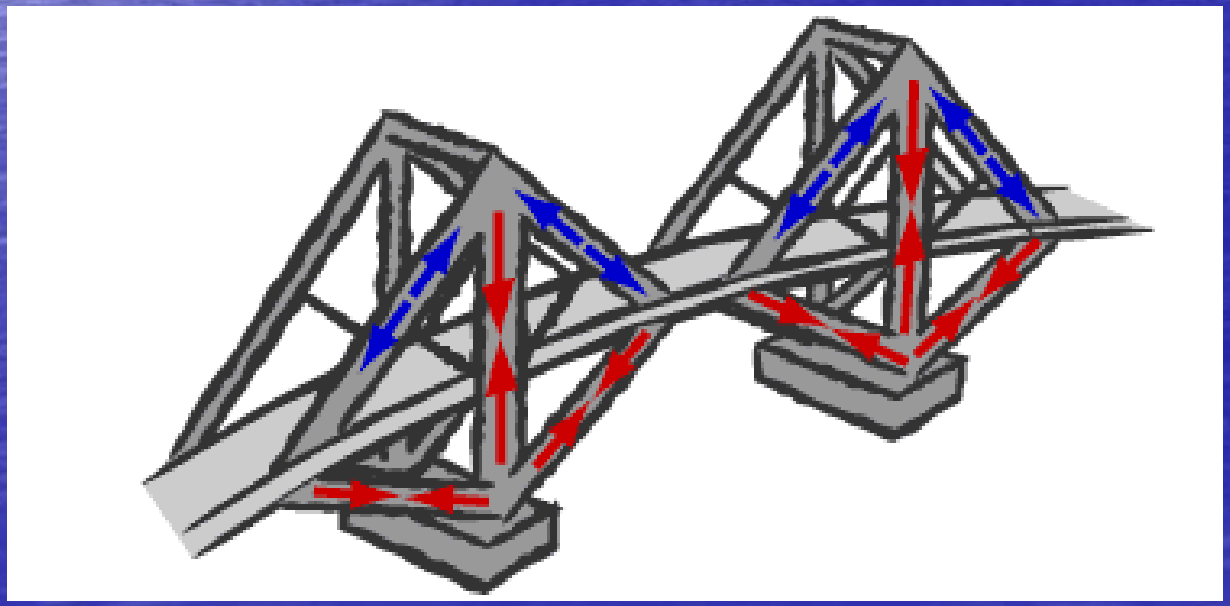
- They are only as rigid as the deck structure. This makes them generally unsuitable for railway traffic.
- During construction, the cables and towers may be susceptible to wind induced oscillations.

Suspension Bridge

Suspension Bridge

Truss Bridges

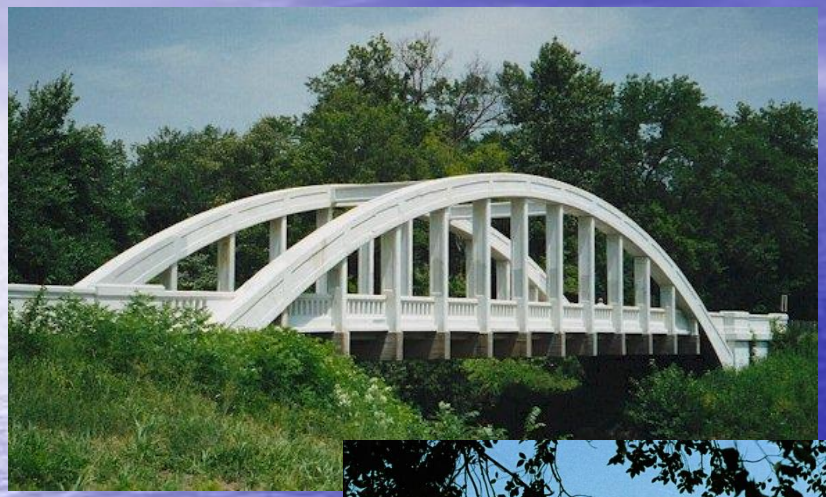
- Uses a system of triangles to cross brace
- Easy to mass produce
- Used for railroad bridges



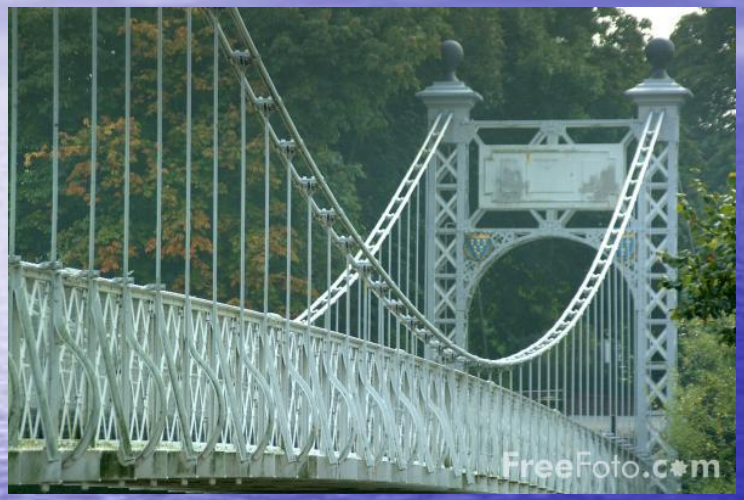
Truss Bridge

Beam Bridges

Arch Bridge



Suspension Bridge



Truss Bridge

Other Bridges

- Cable Stayed Bridges – consists of one or more columns called pylons or towers with cables supporting the bridge deck

Other Bridges (continued)

- Pontoon Bridges – floating bridges supported by pontoons

Why Bridges Fail

- Weather (flooding, wind, rain, etc.)
- Poor/wrong design
- Change in substrate
- Failing parts

Tacoma Narrows Bridge 1940